# Multi-Track Bottom-Up Synthesis from Non-Flattened AZee Scores

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# Introduction

- **Sign language Synthesis:** Converting a sign language utterance description into an avatar animation.
- We present an algorithm to improve the pre-existing bottom-up animation system for AZee descriptions to synthesize sign language utterances (Nunnari et al., 2018).
- Our algorithm allows us to synthesize AZee descriptions by preserving the dynamics of underlying blocks.

# Animating from AZee

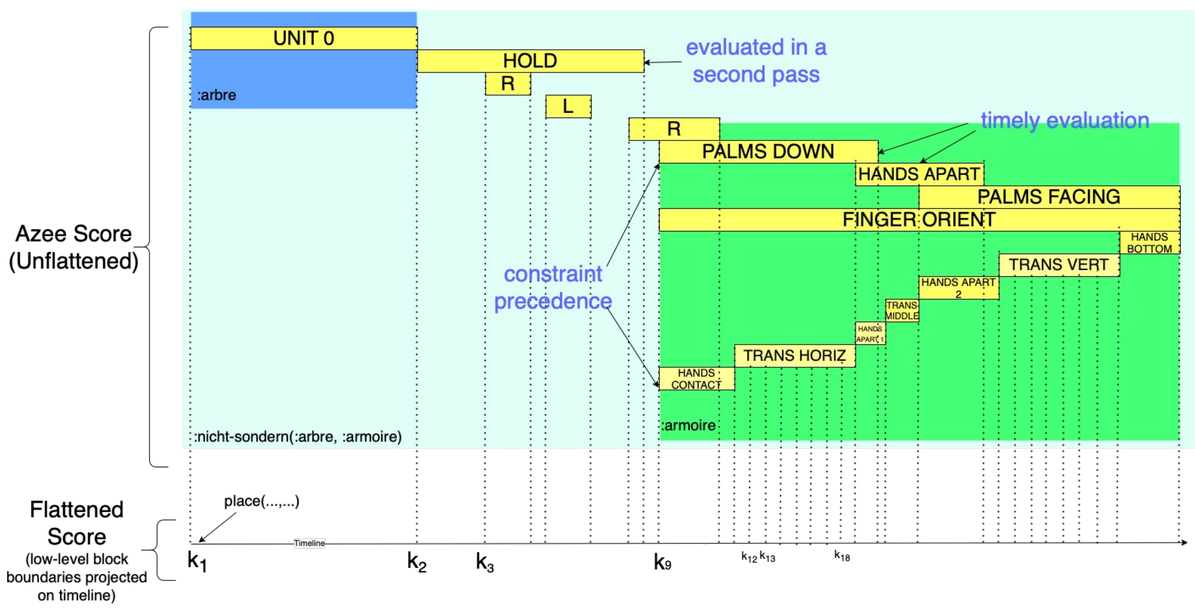



Figure 1 – *Flattened* and *Unflattened* results of :nicht-sondern(:arbre, :armoire)

**Synthesis from the Bottom Up**

- Using minimal constraints.
- Generates Robotic animation
- Can synthesize any sign language utterance description

**Placement and orientation constraints in AZee**

Figure 2 – Place @I_TIP(s) at @FH

Figure 3 – Orient DIR!f_arm(s) along DIR!f_arm(w)

# Problem

An AZee description specifies all parts of the utterance to render with the avatar (blocks in figure 1) and their timing, including interpolation information. The *Unflattened* Score produced by AZee reflects all of this.

- *Flattening* this score will break the dynamics of these interpolations($k_1$, $k_2$, ... $k_n$)
- Not *flattening* separates constraints that should be handled jointly(for example “PALMS DOWN” and “HANDS CONTACT”)

# Approach

To build a system to synthesize from the *unflattened* AZee score. We impose a certain set of rules while constructing the multi-track timeline.

**1. Timely Evaluation**

**Problem:** Time overlapping blocks containing constraints that act on the same bone chain but do not start at the same time.

**Example:** PALMS DOWN and HANDS APART in figure 1.

**Response:** Chronological evaluation of such blocks.

**2. Constraint Precedence**

**Problem:** Time overlapping blocks containing constraints that act on the same bone chain but start at the exact same time.

**Example:** PALMS DOWN and HANDS CONTACT in figure 1.

**Response:** Precedence is given to the block containing placement constraints over those with orientation constraints.

**3. Second Pass for Transpaths**

**TRANSPATH** constraint specifies the interpolation between two blocks

**Problem:** Block contains a transpath constraint, Therefore depends on the preceding and the following blocks.

**Example:** TRANS HORIZ in figure 4.

**Response:** Evaluate blocks containing transpaths in a Second Pass.

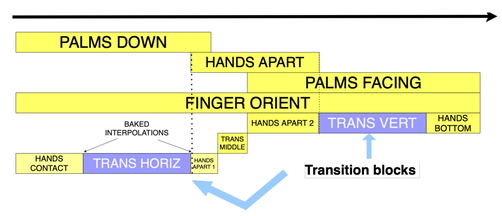



Figure 4 – Second pass for transpaths

**4. Second Pass for Holds**

**HOLD** constraint specifies that constraints of some other block have to held for a duration

**Problem:** Block contains a hold constraint, Therefore depends on another block.

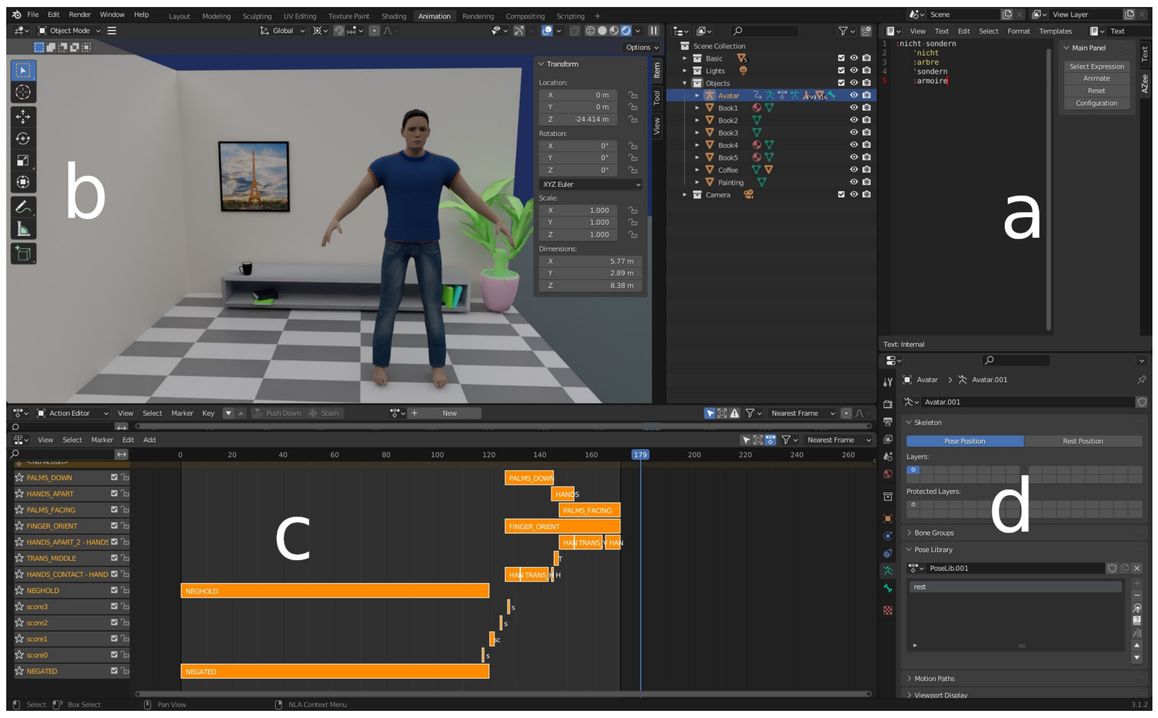
**Example:** HOLD in figure 1.

**Response:** Evaluate blocks containing holds in a Second Pass.

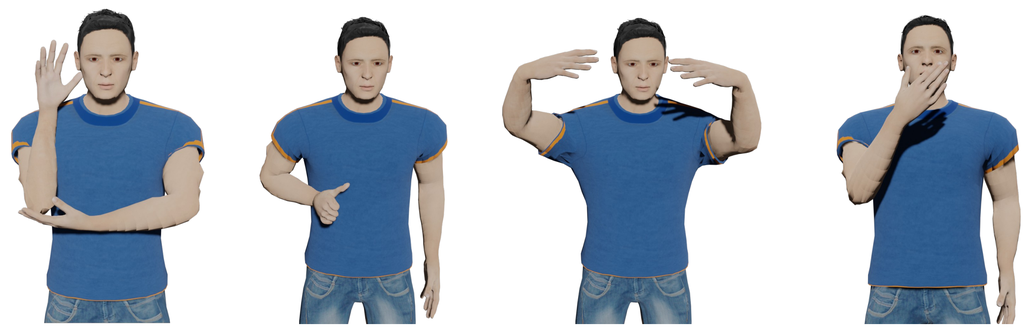
Any case not mentioned above will be clear of conflicts and can be evaluated independently. These include:

- all blocks not overlapping each other on the timeline;
- overlapping blocks that act on different bone chains;
- other constraints such as morph and look act independently from the others.

# Implementation and Results




Main Blender interface. (a) AZee editor. (b) 3D Viewport. (c) Non-linear Editor. (d) Properties panel

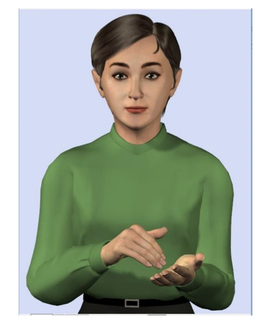


(from left to right)Synthesized renders of :arbre, :bien, :armoire and :bonjour

Synthesized :armoire using *flattened* and *unflattened* approach

# Conclusion and Future Work

- Integrate a top-down search to have a combined approach to animate AZee descriptions (example: the Paula animation system)
- Morph constraints
- Ambient noise analysis and style transfer techniques



Paula sign language animation system